$\frac{1}{\lambda} = \bar{\nu} = RZ^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$ ($n_1 < n_2$)

$\frac{1}{\lambda} = RZ^2\left[\frac{n_2^2 - n_1^2}{n_1^2 n_2^2}\right]$

$\lambda = \frac{1}{RZ^2}\left[\frac{n_1^2 n_2^2}{n_2^2 - n_1^2}\right]$

$R = 1.09 \times 10^7\ m^{-1}$
$\approx 10^7\ m^{-1}$

$\frac{1}{R} = 911\text{A}^\circ = 911 \times 10^{-10}\ m$
$\approx 10^{-7}\ m$

Qs: e⁻ makes transition from $4 \longrightarrow 3$ (He^+)
$\lambda = ?$

Sol^n: $\lambda = \frac{1}{R(2)^2}\left[\frac{(3)^2(4)^2}{4^2 - 3^2}\right]$

$\lambda = \frac{9 \times 7}{(16-9) \times 4R}$

$= \frac{36}{7R}$

Hydrogen
Qs: λ_{max} for Lyman Series?

Sol^n $\Rightarrow$ $\lambda_{max} = \lambda_{2\to1} = \frac{1}{R}\left[\frac{(1)^2(2)^2}{4-1}\right]$

$\lambda = \frac{4}{3R}$

H-atom
Qs: λ_{min} (Lyman) $= \frac{1}{R}$
λ_{min} (Balmer) $= \frac{(2)^2}{R}$
λ_{min} (Paschen) $= \frac{(3)^2}{R}$
λ_{min} (Brackett) $= \frac{4^2}{R}$
λ_{min} (Pfund) $= \frac{5^2}{R}$

$\frac{1}{\lambda} = RZ^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

$\infty \longrightarrow n$ ($n_2 \to \infty$, $n_1 \to n$)

$\frac{1}{\lambda} = RZ^2\left[\frac{1}{n^2} - \frac{1}{\infty}\right]$

$\frac{1}{\lambda} = \frac{RZ^2}{n^2}$

$\lambda = \frac{n^2}{RZ^2}$

$(\lambda_H)_{\infty \to n} = \frac{n^2}{R}$

(#) No. of spectral lines observed in Emission spectrum (different) = No. of photons emitted with diff λ

$n_2 \to$ High level
$n_1 \to$ low level

$N = \frac{(n_2 - n_1)(n_2 - n_1 + 1)}{2}$ (No. of spectral lines observed)

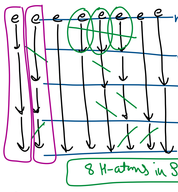
Qs: In a sample of excited H-atoms, e⁻ make transition from 4th excited state to ground state. No. of spectral lines observed?

$n_2 = 5$, $n_1 = 1$

Sol^n $\Rightarrow$ $5 \longrightarrow 1$

$N = \frac{(5-1)(5-1+1)}{2} = \frac{4 \times 5}{2} = 10$

No. of lines in Visible Region $\Rightarrow 5 - 2 = 3$ lines
" " " UV Region $\Rightarrow 5 - 1 \Rightarrow 4$ lines $\Rightarrow$ Lyman
" " " Paschen Series $\Rightarrow 5 - 3 \Rightarrow 2$ lines



8 H-atoms in Sample

(#) $5 \to 4$, $5 \to 3$, $5 \to 2$, $5 \to 1$
$4 \to 3$, $4 \to 2$, $4 \to 1$
$3 \to 2$, $3 \to 1$
$2 \to 1$

Lyman Series
Balmer Series (Visible)

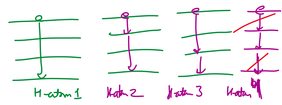
Qs: No. of lines in Spectrum when e⁻ makes transition from $5 \to 1$ (Excluding Visible Region)

Sol^n $\Rightarrow$ 6

Qs: $4 \to 1$ N = ? H-atoms in Sample?

Sol^n: $4 \to 3$, $4 \to 2$, $4 \to 1$, $3 \to 2$, $3 \to 1$, $2 \to 1$

N = 6



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de-Broglie concept of Matter Waves (Particle Waves)

→ only for very small particles (Microscopic particles)

$\lambda \propto \frac{1}{p}$

$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2m(K.E)}} = \frac{h}{mv}$

$p = mv$
$p^2 = m^2v^2$
$\frac{p^2}{2m} = (K.E)$
$p = \sqrt{2m(K.E)}$

$\lambda = \frac{h}{\sqrt{2m(q.V)}}$

→ when charged particle is accelerated under P.d of "V" volts & mass of particle is m & charge of particle is q

(*) $(K.E)_e = eV$

(*) $(K.E)_x = q_x V = 2eV$ (He^{2+})

V (P.d)

$E = mc^2$
$h\nu = mc^2$
$m = \frac{hc}{c^2\lambda}$
$m = \frac{h}{c\lambda}$
→ mass of photon

Qs: $(K.E)_e = 2.5 \times 10^{-24}$ J.
$\lambda_e = ?$

Sol^n $\lambda = \frac{h}{\sqrt{2m_e \times (K.E)_e}} = \frac{6.6 \times 10^{-34}}{\sqrt{2 \times 9.1 \times 10^{-31} \times \frac{5}{2} \times 10^{-24}}}$

$= \frac{6.6 \times 10^{-34}}{\sqrt{455 \times 10^{-54} \times 10^{-1}}}$

$= \frac{6.6 \times 10^{-34}}{\sqrt{\frac{45.5}{10} \times 10^{-54}}}$

$\sqrt{4.5} = \sqrt{\frac{9}{2}}$

$= \frac{3}{\frac{3}{2}} \approx 2$

$= \frac{6.6}{2.2} \times \frac{10^{-34}}{10^{-27}}\ m$

$= 3 \times 10^{-7}\ m \times \frac{10^{-3}}{10^{-3}}$

$= 3000\ \text{A}^\circ$

$= 300\ nm$

H.W ⇒ Ecap → 1 to 4
Exercise → upto 1.3 (Q → 17)